

ABSTRACT

2 A digital synthesizer generates an electrical digital carrier that is converted to
analog and driven a probe coil to generate an electromagnetic wave propagated into a test
4 material proximate the probe coil. A return electromagnetic wave generated by eddy
currents in the material includes signatures of material defects modulated on the return
6 carrier electromagnetic wave. The return wave is detected by one or more probe coils
and amplified. A second amplifier is applied selectively amplifying the signal in
8 segments such that each segment exploits the input range of the analog to digital
converter. The signal is then converted from an analog signal to a digital signal and then
10 digitally mixed with digital sine and cosine functions also generated by the digital
synthesizer to yield sum and difference values. A gain scaling stage then trims the signal
12 to overcome circuit imprecision such that the amplification in each respective segment is
a power of two. A low pass filter then removes all but the difference values, leaving only
14 the small eddy current signal. A direct current reference component is subtracted from
the mixed digital signal, which translates the signal to center about a zero axis for ease of
16 display and analysis. A bit shifter then reverses the selective signal amplification by
simply shifting bits in the digital representation of the signal corresponding to the prior
18 selective amplification.